 RECEIVED CENTRAL FAX CENTER DEC 29 2004

Dec 29, 2004

To: 703-872-9306
PTO

Response to Office Action of Nov. 2004: U.S. No. 09/986,057 (Nov 7, 2001)
(and Provisional Filing Nov 7, 2000)

Dear Sirs:

You will receive the full Express Mailed response to the office action on U.S. No. 986,057 within a few days.

The opening pages of the response follow. The key attachments to show the state of the art for satellite communication frequencies will follow in the mail.

Regards,

Paul F Christopher

Paul Christopher

312 Loudoun St, SW
Leesburg, VA 20175
pfchristop@aol.com
Dec. 29, 2004

Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sirs,

Thank you for sending the Patent and Trademark office action, concerning my Nov. 7 2001 Filing (U. S. Patent Application No. 09/986,057) and my Nov. 7 2000 Provisional Filing. The office action entailed a lot of material, and my response is included here.

Much of the office action was concerned with state of the art at the time of the filing. Since so much time has elapsed since the filing, I felt compelled to start with a preface to lay out the state of the art from the mid 90's to the present. Key attachments from 1981 to 2004 are included to show the evolution of the state of the art.

My comments on the PTO use of the Mendenhall and Badesha filings then follow, where I show the relations to the present filing and the entirely different emphasis. I also address a concern with the date of the Badesha filing, as it appears to follow my Nov. 7 2000 Provisional Filing.

The third part gives my response to the PTO detailed action.

Please contact me if you need more material.

Regards,

Paul F. Christopher

Paul F. Christopher

cc William Sekyi, Arnold and Porter

12/30/04

Preface to Response to PTO Rejection of Claims
Title: Broadband Communication for Satellite-Ground or Air-Ground Links,
(Nov. 7, 2001; Provisional Filing Nov. 7, 2000)
Inventor: Paul F. Christopher
U.S. Patent Application No. 09/986,057

The Patent and Trademark Office has centered the rejection of the Claims of the Filing (Christopher, U.S. Patent Application No. 09/986,057, Filing Nov.7, 2001; Provisional Filing Nov. 7, 2000) on the assertion that the Filing is only "the State of the Art." This preface addresses the state of the art from the period of the mid -90s to the present time. The preface will show that the inventor's attenuation equations, the global attenuation maps, the choice of appropriate satellite orbits, and the global topography of optimum frequencies did not exist until the inventor developed them in the period from 1999 to 2001.

Before beginning this preface, the PTO may wish to review the state of the art of satellite communications in 1997. The IEEE Proceedings Special Issue on Ka Band Communications (June, 1997) addressed the highest reasonable frequencies that the distinguished editorial board could reasonably conceive. The key authors addressed the difficulty of communication in the presence of rain attenuation at 30 GHz and 20 GHz throughout the entire issue. The problems were assumed to range from difficult to overwhelming. The difficult attenuation problems were compounded with the choice of satellite test sites with low ground elevation angles. The low elevation angles implied long atmospheric path lengths, with resultant high attenuation.

A careful perusal of the June 1997 Special Issue on Ka Band Satellite Communication reveals that *no frequencies higher than 30 GHz were discussed.* This was due not only to the sheer magnitude of the attenuation problems encountered at 30 GHz, but also to the limitations of their gaseous attenuation model. The gaseous attenuation model was based on terrestrial attenuation that was not appropriate for satellite-ground links. It was recognized to be inappropriate for frequencies greater than 40 GHz.

The correct gaseous attenuation equation was developed by the inventor, and presented at the International Communications Conference in June 1981 (Attachment 1). It showed the critical development of gaseous attenuation around the oxygen resonance at 60 GHz. The closed form result gave accurate insights into reasonable attenuation up to 50 GHz. It also gave results for the 70- 100 GHz region, which were not exploited until the inventor's 1999 paper at the Ka and Broadband Conference at Taormina Sicily (Attachment 2).

Attachment 2 (1999) recognized at the outset that key new Italian results would allow the development of new global attenuation maps. The inventor derived functional forms for these new attenuation maps and listed a new short form in the Appendix. This algorithm was the first available convenient fast form for zenith attenuation. The algorithm appeared patentable in its own right, but the inventor wished to compare satellite constellations with it. It allowed comparisons of atmospheric attenuation for different satellite configurations.

The 1999 paper inspired the comparison of several satellite constellations in 2000 (Attachment 3). These constellations had not been compared, and could not be compared for communication performance, without the attenuation model (Att. 2). High elevation

angle elliptic satellites that also included a class of available Molniya satellites looked especially attractive. Low loss and much higher frequencies were allowed with these high elevation satellites. The much higher frequencies, as 30-49 GHz and in some cases 75- 98 GHz, implied a significant new use for elliptic satellites. This was a striking case of critical interaction of satellite orbits and useful frequencies. The new use for the orbits implied such a sharp spectral change that it appeared patentable.

The inventor's paper at the January 2001 SPIE meeting [Att. 4] was a central reference in the inventor's Nov. 7, 2000 Provisional Filing and the Nov. 7, 2001 Filing. The inventor presented the paper in San Jose He addressed the possibility that 10 micron laser radiation could be successfully used for satellite- ground communication in key communication areas such as the Northeastern United States. *This was a sharp change from prior concepts of satellite-ground laser communication experiments,* which anticipated remote, cloud free sites such as Mt. Lemmon AZ. The change was permitted by the inventor's global cloud attenuation maps and the recognition that a change in wavelength from the state-of-the-art 1 micron lasers to 10 microns would be critical. Short atmospheric path lengths to inclined, elliptic satellites were also critical. Ten micron laser attenuation was seen to be modest at Bangor, Maine and at Oslo, Norway. The inventor proposed new high data rate links for trans-Atlantic communication for paired sites like Bangor and Oslo.

The inventor found continued use for his global attenuation maps at the 2002 Ka Conference in Baveno-Stresa, Italy (Att. 5). The attenuation model was used to model uplink interference from proposed Ultra Wideband communication devices.

The inventor used his papers at the Nov. 2003 Ka conference at the Isle of Ischia [Att. 6, Att. 7] as vital references for his later filings (Oct 27 2003 Provisional Filing, Oct 14, 2004 Filing, Application No. US 10/964,543). Those filings represent key extensions to the present discussion, and will not be further discussed here.

The inventor also used his global atmospheric attenuation model for a new military application at MILCOM 2004 on Nov 2, 2004 (Att. 7). It was able to anticipate improved communication with atmospheric reentry vehicles by switching from the NASA 2.2 GHz band to 26- 45 GHz, and higher millimeter wave frequencies.

To conclude this brief overview of higher frequencies for satellite communication, it is worthwhile to see how the IEEE view of higher frequencies has changed. The near-total neglect of frequencies greater than 30 GHz in June 1997 has changed to the confident Jet Propulsion Lab plans (Dr. David Morabito, Ka Conference, Vicenza, Italy, Oct. 2004) for 40-41 GHz for deep space links. His distinguished colleague Dr. Faramaz Davarian has a companion article on Ka band for deep space links- ground (IEEE Proceedings, Dec. 2004).

References for Attachments

1. A.K. Kamal, P. Christopher, "Communications at Millimeter Wavelengths," Proc. ICC , Denver, June 1981. (Att. 1 is the associated MITRE document).

2. Paul Christopher, "World Wide Millimeter Wave Attenuation Functions from Barbaliscia's 49/22 GHz Observations," Proc. Ka Conference, Taormina Sicily, Oct. 1999.

3. Paul Christopher, "Satellite Constellations for Ka Band Communication," Proc. Ka Conference, Cleveland, OH, June 2000.

4. Paul Christopher, "Worldwide Infrared and Millimeter Wave Satellite Performance," Proc. SPIE Optical Communications Conference, San Jose, CA, Jan. 2001.

5. Paul Christopher, "Ultra Wideband Interference into Ka Band Satellite Systems," Proc. Ka and Broadband Conference, Baveno-Stresa Italy, Nov. 2002.

6. Paul Christopher, "Millimeter Waves for Broadband Satellite Communication, 75-98 GHz," Proc. Ka and Broadband Conference, Isle of Ischia, Italy, Nov. 2003.

7. Paul Christopher, "Diversity Advantages for Nearby Sites, with Furuhama's Rain Correlation Function," Proc. Ka and Broadband Conference, Isle of Ischia, Italy, Nov. 2003.

8. Paul Christopher, "Optimum Communication and Surveillance Frequencies for Atmospheric Reentry Vehicles," Proc. Milcom 2004, Monterey, CA, Nov. 2004.

12/30/04

Comments on Todd L. Mendenhall et al, Filed Jan 13, 2000 US 6,535,314 B1
SATELLITE OPTICAL COMMUNICATION ACQUISITION TECHNIQUES
date of patent Mar 18, 2003

This valuable patent will allow laser communication systems to acquire the laser beam more readily. It will provide valuable concepts and devices for rapid signal acquisition. The Mendenhall invention is an important aid in satellite communication system, but it does not determine the efficacy of ground locations and orbits. It also leaves the question of frequency unaddressed. It is stated to be an optical system, as was consistent with systems of the year 2000 era. As an optical system, the system can be assumed to have wavelength on the order of 1 micron (or at most 1.3 microns, to coincide with state of the art laser sources in 2000).

Note,

- (1) It does not relate to the overall viability of laser satellite systems in valuable communication regions, as populated areas of the U.S.
- (2) It does not address how to get adequate signal strength in difficult but valuable areas, such as the northeastern U.S.
- (3) It does not address the need for non-standard orbits, such as Molniya orbits for good communication in the northeastern U.S.
- (4) It does not address the choice of optimum laser frequencies. The typical one micron laser system would give totally unacceptable performance outside the southwestern U.S (shown in Christopher, SPIE Jan 2001).

(5) Unlike the PTO assertion, Mendenhall does not make an equivalence

between optical and IR communication. This is for two reasons: first, 10 micron infrared communication effectively did not exist at the time of the invention, and secondly these two wavelengths are not treated as equivalent by optical communicators. This difficult non-equivalence was well recognized, and major studies were just getting underway in Nov 2000 (Frank Hanson, SPIE Optical Engineering) to see find the key signal propagation differences between 1 micron, 3 micron, and 10 micron radiation.

Indeed, the concepts of signal attenuation in the atmosphere are missing from Mendenhall, et al. This is because all test concepts through 2001 used proposed test sites as Mt. Lemmon, AZ. Most discussion of atmospheric attenuation in valuable sites was simply avoided. (This was for good reason, because important components such as Mendenhall's tracker needed their own key tests).

The PTO assertion that the ground sites would be chosen at good sites as simply 'state of the art' would lead to singularly non-useful communication sites. For most useful satellite communication, ground sites would need to be considered outside Arizona or Death Valley.

The Christopher filing addresses *both* reasonable locations (with cloud attenuation maps) and the need for short atmospheric path length with the choice of good satellite orbits (e.g., Molniya orbits for the northeastern U.S). *The Christopher filing further recognizes that these two steps would not be enough*: The Christopher filing finally recognizes that the 1 micron (optical) systems typically chosen for test at Mt. Lemmon

would give poor performance (poor signal level) at most other locations. Wavelengths near 10 microns would usually give much better performance.

The combination of both Mendenhall and Christopher concepts would be expected to lead to a useful laser communication system. They are complementary, rather than exclusive.

12/6/04

Comments on Surjit S. Badesha, et al, Pub. No. US 2002/0167702 A1

Optical Communication System Using a High Altitude Tethered Balloon

and comparison to Christopher US09/986,057 (Nov. 7, 2001; Provisional Filing was recorded Nov. 7, 2000)

The Badesha filing will possibly have important uses, as returning high data rates from space probes via tethered high altitude platforms to a central receiving site. It could be important for sites such as the NASA White Sands site when carrier frequencies are raised to the upper millimeter wave region or if laser frequencies are needed for space-ground communication.

The PTO may wish to check the dates on the Badesha filing. The Jul 3 2002 and Jan 9 2001 filing dates do not appear to precede the Nov. 7 2000 Provisional Filing date on the Christopher filing.

The Badesha filing does not, however, meet the needs of most satellite communications users. By serving a single ground site, it has avoided the atmospheric losses that most users need to consider before choosing a frequency or a satellite system.

Atmospheric losses have been recognized to be the central issue for decades (see the preceding preface, and Attachments). Christopher has addressed this issue directly by

studying atmospheric losses as a function of frequency, and by studying satellites that would relieve the normal massive atmospheric attenuation at frequencies> 30 GHz.

The Christopher filing is concerned with a preponderant number of ground users in a satellite system, and *should not be compared* with the Badesha filing:

A typically useful satellite system (e.g., Christopher, 2001) would:

- Serve a large number of ground terminals, as thousands or hundreds of thousands. Examples would include a direct satellite to ground TV system.
  - –The homeowners would find the 'last mile' interconnect costs prohibitive for the Badesha concept.

Another useful satellite system will have military uses in the near future (Martin Shelley, Ka Conference, Vicenza, Italy, Oct. 2, 2004).

-The satellite-ground system will service thousands of military vehicles.

--Low profile antennas have been developed for HumVees, specifically for these demands.

-A larger context for military satellite systems has been addressed at Milcom 2004.

--Every small user in the service would have a link to a Global Information Grid. (GIG). This would usually mean that every small (DoD) user would have a link to a military satellite. The Wideband Gapfiller Satellite (Dec 2005) is envisioned to fill this kind of need.

The Christopher filing is intended to address these kinds of needs, and to deliver the much higher data rates than can be found at frequencies<15 GHz.

The Badesha filing will not, and should not, be considered for these large scale satellite-ground communication links.